Dissertation viva

Topic**: Legal regulations governing Algorithmic trading in India -A study with special reference to EU & US**

1. **WHY THIS TOPIC & RELEVANCE TO LLM CCL**

   This is relevant or I have chosen because algorithmic trading sits at the intersection of financial markets law, corporate governance, and securities regulation, all of which are core to Corporate and Commercial Law. As an LLM CCL student, understanding how corporations and financial intermediaries are regulated in automated markets is critically important. Algorithmic trading is no longer confined to institutional investors. With SEBI's 2024–2025 reforms opening API-based trading to retail participants, the legal and compliance landscape for brokers, exchanges, and trading firms has changed dramatically. This directly concerns corporate accountability, intermediary liability, and investor protection.

   Moreover, from a commercial law perspective, the contractual and liability frameworks between algorithm providers, brokers, and exchanges are still underdeveloped in India. There is no single comprehensive statute the regulation happens through circulars and guidelines. This creates legal uncertainty for commercial entities operating in capital markets.

2. LITERATURE REVIEW

   "I have reviewed **40 literature sources** across academic journals, regulatory documents, working papers, and policy reports spanning from 2011 to 2025."

   IN Indian Authors (mention these 3):

   1. Anurag Singh (2025) *"Algorithmic Trading and Market Manipulation: A Legal Perspective on Insider Trading Regulations"* — He examined SEBI's Insider Trading Regulations 2015 and found that the existing legal framework is premised on human intent, which is unattainable in algorithms. He highlighted the Adani-Hindenburg case as a regulatory failure example.

   2. Chandrarupa Chatterjee (2024) *"Algo-based Trading in the Indian Markets: Analysing in Context of SEBI Regulations"* — She traced SEBI's regulatory evolution and argued that the Indian framework, being mostly circular-based rather than statutory, lacks the systematic legal basis that MiFID II has. She found the Indian model to be procedural and reactive.

3. Drishti Rawat (2024) *"SEBI Regulatory Framework for Algorithmic Trading: Ensuring Market Fairness"* — She analysed SEBI's certification processes, pre-trade controls, and circuit breakers and recommended that India must move from guided circulars to codified statutory regulation to ensure enforceable and arbitrage-free regulation.

🌍 **Foreign Authors (mention these 3):**

1. Rabeea Sadaf et al. (2021) — EU *"Algorithmic Trading, High-Frequency Trading: Implications for MiFID II and MAR in the EU"* — They found that despite MiFID II's expanded surveillance scope, the volume of market data, limited regulatory resources, and difficulty in detecting manipulative intent in machine-driven markets make implementation very difficult.

2. Andrei A. Kirilenko & Andrew W. Lo (2013) — US *"Moore's Law versus Murphy's Law: Algorithmic Trading and Its Discontents"* — They identified the fundamental tension between technological advancement and regulatory capacity. They found that regulatory lag, compliance costs, and the self-learning nature of AI systems are persistent gaps in all jurisdictions including the US.

3. Tilen Cuk & Arnaud Van Wayenberge (2018) — EU *"European Legal Framework for Algorithmic and High-Frequency Trading (MiFID II and MAR): A Global Approach"* — They confirmed that EU's framework is strict and integrated but noted that real-world implementation requires iterative adjustments and that legal uncertainty remains in rapidly innovating markets.

📌 **GAP IN LITERATURE & HOW YOUR RESEARCH FILLS IT:**

What to say:

"After reviewing all 40 sources, I identified **three consistent gaps** in existing literature:

Gap 1 — India-specific statutory analysis is missing. Most Indian scholarship focuses on SEBI circulars in isolation without critically comparing them to codified legislative frameworks like MiFID II. There was no comprehensive doctrinal study that placed India's circular-based system directly against EU statutory law and US principles-based regulation side by side.

Gap 2 — AI and ML in trading is under-regulated and under-researched in Indian context. Authors like the FSB (2017) and ESMA (2014) flagged AI governance gaps globally, but no Indian legal scholar had specifically examined how SEBI's existing framework handles self-learning, adaptive algorithms which are fundamentally different from rule-based algorithms.

Gap 3 — Retail investor protection in algorithmic trading is largely ignored. Almost all comparative studies focused on institutional or high-frequency traders. The 2024–2025 SEBI retail algo trading circular opened a new legal frontier that had not been academically analysed at the time of writing.

How my research fills this gap: My dissertation conducts a comprehensive doctrinal and comparative analysis across all three jurisdictions India, EU, and US using primary legal sources: statutes, SEBI circulars, MiFID II, MAR, SEC rules, and CFTC regulations. I analyse enforcement actions, judicial precedents, and consultation papers to bridge the gap between black-letter law and real-world regulatory practice. I also specifically address retail participation, AI governance, and the adequacy of India's circular-based system versus statutory codification."

3. STATEMENT OF PROBLEM (RESEARCH GAP)

"The central problem my dissertation addresses is this:

Algorithmic trading especially API-based and high-frequency trading has transformed Indian securities markets, yet India's regulatory framework remains **fragmented, circular-dependent, and disproportionately prescriptive** compared to international standards.

Specifically:

- Before SEBI's 2024 reforms, retail algorithmic trading through broker APIs was virtually unregulated creating space for flash crashes, spoofing, layering, and systemic manipulation.
- Regulatory arbitrage was rampant traders could shift operations offshore to circumvent Indian regulation while still affecting domestic markets.
- There is no single comprehensive statute governing algorithmic trading in India, unlike the EU where MiFID II provides a unified legally binding framework.

- India's prescriptive approach mandatory pre-approval of every algorithm, API whitelisting, static IP requirements increases compliance costs and may deter fintech innovation and retail participation.
- The attribution of liability when an algorithm causes market harm is legally unclear in India.

  The core research gap is: **whether India's current regulatory approach strikes the right balance between investor protection, market integrity, and innovation** and if not, what reforms are needed drawing from EU and US best practices."

4. RESEARCH QUESTIONS

Say these confidently and link each to a chapter:

RQ1: *How well do India's new rules on algorithmic trading guard against market manipulation and preserve market integrity?* → Answered primarily in **Chapter IV (Section 4.1)** and **Chapter VI** through SEBI enforcement actions and SAT judgments like *SEBI v. Rakhi Trading Pvt. Ltd. (2018)* and *Ketan Parekh v. SEBI (2006).*

India's regulatory response to algorithmic trading has evolved in three clear phases under SEBI — Securities and Exchange Board of India.

Phase 1 — Foundation (2012): The **Broad Guidelines on Algorithmic Trading Circular (CIR/MRD/DP/09/2012)** mandated exchange-level pre-approval of all algorithms, mock testing before deployment, and placed primary liability on stockbrokers for all algorithmic orders.

Phase 2 — Strengthening (2013–2015): The **Risk Controls Circular (2013)** introduced mandatory kill switches, price checks, quantity limits, and order-to-trade ratio thresholds. The **Enhanced Supervision Circular (2015)** added unique strategy identifiers and periodic SEBI-empanelled audits.

Phase 3 — Retail Algo Reforms (2024–2025): The **Retail Algorithmic Trading Circular (2024)** was the most significant step — bringing non-institutional traders under formal regulation for the first time through mandatory algorithm provider registration, API whitelisting, and static IP address controls.

How these measures address market manipulation specifically:

Against **spoofing and layering** where traders place and cancel large orders to create false price signals SEBI's order-to-trade ratio restrictions and real-time surveillance mechanisms create detection and deterrence.
Against **flash crashes** — SEBI mandates circuit breakers and price band mechanisms at exchange level that automatically halt trading when price movements breach specified thresholds. These were reinforced after global events like the 2010 US Flash Crash.

Critical Assessment: However, despite these measures, several gaps remain. First, the framework is **circular-dependent** and lacks statutory backing unlike MiFID II in the EU which is primary legislation. This reduces enforceability and creates legal uncertainty. Second, attribution of liability when an algorithm causes harm is unclear the framework is broker-centric but does not clearly extend liability to algorithm developers or strategy providers. Third, **AI and machine learning based algorithms** which are self-learning and adaptive are not specifically addressed in any SEBI circular, creating a regulatory blind spot.

RQ2: *Does India's regulatory model strike the right balance between innovation and oversight compared to principle-based (US) and transparency-driven (EU) regimes?*
→ Answered in **Chapter IV (Section 4.4 — Comparative Analysis)** and **Chapter VII (Conclusion & Suggestions).**
To answer this I compare the three regulatory philosophies directly.
India under SEBI is the most prescriptive every algorithm requires pre-approval, APIs are restricted, and brokers carry comprehensive compliance responsibility. This protects investors effectively but creates high compliance costs and operational bottlenecks that may deter fintech innovation and retail participation.

The EU under MiFID II — Markets in Financial Instruments Directive II (Directive 2014/65/EU) does not require algorithm-by-algorithm pre-approval. Instead it mandates comprehensive documentation, annual testing, real-time monitoring, and senior management accountability. ESMA European Securities and Markets Authority ensures uniform implementation through binding **RTS 6 — Regulatory Technical Standard 6** which is the specific operational rulebook for

algorithmic trading. This model is innovation-friendly while maintaining strong accountability.

The US under the Securities Exchange Act 1934, Dodd-Frank Act 2010, and the Market Access Rule — Rule 15c3-5 is the most flexible. It trusts firms to design their own internal risk controls within broad principles. The SEC Securities and Exchange Commission and CFTC Commodity Futures Trading Commission intervene primarily through post-trade enforcement rather than pre-approval.

The balance assessment: India **over-regulates process and under-regulates outcomes.** The EU and US focus on what the algorithm must achieve not exactly how it must be built. My dissertation concludes India needs a **hybrid recalibration** adopting EU's statutory clarity and US's outcome-based flexibility moving away from pre-approval bottlenecks toward codified minimum standards with firm-level discretion on implementation."

RQ3: *How do circuit breakers and direct market interventions mitigate the risk of flash crashes or market manipulation across major jurisdictions?* → Answered in **Chapter III (Section 3.3 & 3.4)** and **Chapter V (Section 5.3)** on systemic risk and market stability.

The legal significance of this question stems from the **2010 US Flash Crash** where the Dow Jones dropped 1,000 points in minutes due to cascading algorithmic sell orders. The joint **SEC-CFTC Report (2010)** on this event became the global reference point for circuit breaker reforms.

India's approach: SEBI mandates index-level circuit breakers at 10%, 15%, and 20% movement thresholds on BSE Sensex and NSE Nifty, with scrip-level price bands for individual securities. The **2013 Risk Controls Circular** introduced broker-level kill switches for instantaneous cessation of all algorithmic activity during system anomalies. These have successfully prevented a major flash crash in India.

EU's approach: Under **MiFID II Article 48**, trading venues must maintain volatility management mechanisms including automatic temporary halts. **RTS 6** requires firms to have kill-switch functionality and stress-testing protocols. The EU additionally restricts order-to-trade ratios and mandates minimum tick sizes to prevent quote stuffing where algorithms flood order books to slow competitors.

US's approach: Post Flash Crash, the US introduced **LULD Limit Up-Limit Down mechanisms** preventing trades outside specified price bands for individual securities. The **Market Access Rule (Rule 15c3-5)** requires all broker-dealers to have pre-trade risk controls. **Regulation SCI Regulation Systems Compliance and Integrity** mandates technological resilience at exchange and infrastructure level.

Key legal conclusion: Circuit breakers address the **consequences** of algorithmic failure but not the **cause.** They are reactive tools. All three jurisdictions use them but with different design philosophies EU is most standardized, India most centrally controlled, and US most decentralized. The real protection lies in pre-trade risk governance where EU leads, India is developing, and the US relies on firm-level discretion."

RQ4: *What is the impact of emerging technologies such as AI and machine learning on the adequacy and adaptability of current regulatory frameworks?* → Answered in **Chapter V (Section 5.5)** on algorithmic governance and the future of regulatory design, and **Chapter VII (Suggestions).**

"This is the most forward-looking question and addresses a gap common to all three jurisdictions.

The core legal problem is that AI and machine learning based trading algorithms are **adaptive, opaque, and autonomous** — fundamentally different from rule-based algorithms. They learn from live market data and modify their own strategies. This creates three legal challenges: first, **liability attribution** is unclear because there is no fixed human decision to identify as the source of harm. Second, **pre-approval becomes meaningless** because the algorithm after learning from market data behaves differently from when it was approved. Third, **intent-based market abuse laws** under PFUTP Regulations in India and Section 4c(a) of the Commodity Exchange Act in the US are difficult to apply to systems that have no human intent.

India's position: No specific AI trading regulation exists. SEBI's 2023–2024 consultation papers have discussed strategy-level approval as opposed to code-level

approval but no binding rule has been issued. This is a significant regulatory blind spot.

EU's position: The most advanced. While **MiFID II** does not explicitly address AI, the **EU Artificial Intelligence Act** classifying AI by risk levels is expected to cover high-risk financial market applications. ESMA has clarified that existing MiFID II obligations including annual review and senior management accountability apply equally to AI-based systems.

US's position: The most hands-off. The **FSB Financial Stability Board Report on AI and Machine Learning in Financial Services (2017)** identified opacity and model risk as key concerns. The proposed **Regulation AT Regulation Automated Trading** by the CFTC which would have required source code access was never finalized due to industry opposition.

My recommendation is that India should introduce mandatory explainability requirements for AI algorithms, periodic model validation audits, and a dedicated regulatory sandbox for AI trading strategies drawing from the EU's direction while preserving the flexibility the US model values."

5. RESEARCH OBJECTIVES

State all 5 clearly:

1. To critically examine the **evolution of algorithmic trading regulations in India** — from SEBI's 2012 circular to the 2024–2025 retail algo framework.
2. To examine how **compliance requirements and costs** affect smaller traders, fintechs, and larger institutions differently in adopting algorithmic trading.
3. To **analyse similarities and differences** between India's framework and those of the US (principle-based) and EU (rules-based), focusing on risk controls, innovation, and regulatory philosophy.
4. To analyse how **recent legal frameworks incorporate or respond to emerging technologies** such as AI, ML, and RegTech in algorithmic trading oversight.
5. To analyse **notable enforcement actions and judicial precedents** that have shaped regulatory discourse around algorithmic trading.

6. RESEARCH METHODOLOGY

What to say:

"My research methodology is **qualitative, doctrinal, and comparative.**

Doctrinal approach: I conducted black-letter analysis of primary legal sources — statutes, SEBI circulars, MiFID II, MAR, SEC rules (Market Access Rule, Regulation

SCI), and CFTC regulations. I also examined case law and regulatory enforcement actions.
Comparative legal analysis: I directly compared regulatory philosophies, supervisory practices, and technological adaptation across India, EU, and the US. This is the methodological heart of the dissertation.
Secondary sources: Peer-reviewed journals accessed through JSTOR, Hein Online, Scopus, and Google Scholar; official regulatory portals of SEBI, ESMA, SEC, and CFTC; and policy reports from IOSCO, FSB, and OECD.
Case law analysis: I mapped key judicial precedents including *SEBI v. Rakhi Trading (2018)*, *NSE v. SEBI (2019)*, *US v. Coscia (2017)*, and *CFTC v. Navinder Sarao (2015)*.

8. CONCLUSION AND SUGGESTIONS *(Focus on Suggestions)*

"My dissertation concludes that while India's regulatory framework — built through SEBI's circulars, risk controls, pre-approval requirements, and audit obligations — has **significantly strengthened market integrity and investor protection**, it requires fundamental **recalibration** toward a more flexible, technology-neutral, and internationally harmonized approach.
India's prescriptive model is appropriate for an emerging market with high retail participation, but it imposes **disproportionate compliance costs** and creates **operational bottlenecks** that may impede fintech growth and democratic access to algorithmic trading tools."

📌 **SUGGESTIONS *(Speak on each of these — this is where you should shine)***

Suggestion 1 — Statutory Codification: "India must move from a circular-dependent framework to a **dedicated statutory instrument** governing algorithmic trading — similar to how MiFID II functions in the EU. A separate chapter in the SEBI Act or a standalone Algorithmic Trading (Regulation) Act would provide legal certainty, enforceability, and reduced regulatory arbitrage."

Suggestion 2 — Hybrid Regulatory Model: "India should adopt a **hybrid approach** — combining the EU's specific technical standards and documentation requirements with the **flexibility of the US principles-based model** for internal risk governance. This means: codified minimum standards for all algo traders, but firm-level discretion on how to achieve those standards."

Suggestion 3 — Algorithm Accountability Framework: "India lacks clear legal attribution of liability when an algorithm causes market harm. I recommend introducing an **algorithm accountability framework** that assigns responsibility across the hierarchy — algorithm developer, broker, exchange — with clear standards of due diligence and negligence, similar to senior management accountability under MiFID II."

Suggestion 4 — AI and ML Governance: "SEBI must develop **AI-specific regulatory guidelines** for self-learning algorithms. This should include: mandatory explainability requirements (the algorithm must be capable of producing a human-readable decision trail), periodic model validation audits, and a regulatory sandbox specifically for AI-based trading strategies — as proposed in the EU AI Act."

Suggestion 5 — Retail Investor Protection in Algo Trading: "The 2024–2025 SEBI retail algo circular is a welcome step, but it needs to be strengthened with **mandatory suitability assessments** for retail algo users, risk disclosure obligations on brokers in plain language, and investor education programs — drawing from the EU's best execution and suitability obligations under MiFID II."

Suggestion 6 — Cross-Border Regulatory Cooperation: "Regulatory arbitrage — where traders move to offshore or loosely regulated environments — can only be addressed through **international regulatory cooperation.** India should actively engage with IOSCO and FSB frameworks to align its standards and participate in multilateral supervisory arrangements, particularly with jurisdictions where Indian-registered algo firms operate."

Suggestion 7 — RegTech Investment: "SEBI's surveillance capacity must be modernized. I recommend **mandatory investment in RegTech tools** — AI-powered real-time market surveillance, pattern recognition systems, and cross-market data sharing between NSE, BSE, and SEBI — similar to the SEC's MIDAS system in the US."

9. WHY EU AND US JUSTIFICATION FOR COUNTRY SELECTION

"I chose the **European Union and the United States** as the two reference jurisdictions for four specific reasons:

First Regulatory Diversity: The EU and US represent the **two dominant and philosophically opposite regulatory models** in global financial law. The EU follows a **rules-based, codified, harmonized approach** through MiFID II and MAR. The US follows a **principles-based, enforcement-driven, decentralized approach** through SEC, CFTC, and SROs like FINRA. Comparing India against both extremes gives a complete picture of where India stands and where it should go.

Second — Market Maturity and Technological Leadership: Both the EU and US are the most **technologically advanced algorithmic trading markets** in the world.

HFT originated and grew fastest in these markets. Events like the **2010 US Flash Crash** and **EU's MiFID II reforms** are the defining moments of global algorithmic trading regulation. India's regulatory evolution has been directly influenced by both — SEBI's post-2012 circulars explicitly reference IOSCO principles that emerged from US and EU experiences.

Third — IOSCO and Global Standard Setting: The EU and US are the dominant voices in setting **global regulatory standards** through bodies like IOSCO and FSB. Any reform India undertakes will inevitably need to align with standards shaped by these two jurisdictions. Understanding their frameworks is therefore essential for India's international harmonization.

Fourth — Doctrinal Accessibility: Both jurisdictions have **rich, publicly available primary legal sources** — MiFID II, MAR, Securities Exchange Act, Dodd-Frank Act, SEC rules, CFTC regulations, FINRA rules — as well as extensive **case law and enforcement actions** that make meaningful doctrinal and comparative analysis possible. This made them the most suitable choices for a rigorous legal dissertation."

COMPREHENSIVE THREE-WAY COMPARISON — INDIA vs EU vs US

INDIA — Key Frameworks

1. Securities and Exchange Board of India Act, 1992 (SEBI Act) The parent legislation establishing SEBI as the apex securities regulator. Section 11 gives SEBI the power to protect investor interests and regulate securities markets. All algorithmic trading regulation in India flows from powers exercised under this Act.

2. Securities Contracts (Regulation) Act, 1956 (SCRA) Governs the regulation of stock exchanges and securities transactions. Provides the foundational contract law framework within which algorithmic trading orders operate.

3. SEBI Circular on Broad Guidelines on Algorithmic Trading, 2012 (CIR/MRD/DP/09/2012) India's first comprehensive algorithmic trading regulation. Introduced exchange-level pre-approval of algorithms, mandatory mock testing, and broker accountability for all algo orders.

4. SEBI Circular on Risk Controls for Algorithmic Trading, 2013 (CIR/MRD/DP/16/2013) Introduced mandatory pre-trade risk controls — price checks, quantity limits, value limits, kill switches, and order-to-trade ratio monitoring.

5. SEBI Circular on Enhanced Supervision, 2015 (CIR/MRD/DP/15/2015) Strengthened broker obligations, introduced unique strategy identifiers, periodic system audits, and enhanced surveillance requirements.

6. SEBI Circular on Retail Algorithmic Trading, 2024 Landmark circular extending algorithmic trading regulation to retail investors. Introduced registration of algorithm providers, API whitelisting, static IP address requirements, and enhanced broker compliance obligations for retail algo access.

7. SEBI (Prohibition of Fraudulent and Unfair Trade Practices) Regulations, 2003 (PFUTP Regulations) Primary instrument for prosecuting market manipulation including algo-driven manipulation like spoofing and layering.

8. SEBI (Prohibition of Insider Trading) Regulations, 2015 (PIT Regulations) Applicable where algorithmic systems are used to trade on unpublished price sensitive information.

9. Information Technology Act, 2000 (IT Act) Provides the cybersecurity and data governance backdrop for algorithmic trading systems.

Key Characteristic of India's Model: Prescriptive, exchange-enforced, circular-dependent, pre-approval based, broker-centric liability, emerging market context with high retail participation.

EUROPEAN UNION — Key Frameworks

1. Markets in Financial Instruments Directive II — MiFID II (Directive 2014/65/EU) The cornerstone of EU financial markets regulation that came into force in January 2018. MiFID II is the first legislation globally to **formally define algorithmic trading** and HFT as distinct legal categories. It imposes comprehensive organizational, governance, documentation, and testing obligations on investment firms engaged in algorithmic trading. Key provisions include Article 17 — organizational requirements for algorithmic trading firms; Article 48 — obligations on trading venues; and Article 50 — market-making obligations.

2. Markets in Financial Instruments Regulation — MiFIR (Regulation EU No. 600/2014) The directly applicable regulation that complements MiFID II. MiFIR governs pre and post-trade transparency, mandatory trading obligations, and data reporting requirements. It applies uniformly across all EU member states without the need for national transposition.

3. Market Abuse Regulation — MAR (Regulation EU No. 596/2014) Replaced the earlier Market Abuse Directive and directly targets algorithmic manipulation. MAR explicitly prohibits **spoofing, layering, quote stuffing, and momentum ignition** when carried out through algorithmic means. It requires firms to have surveillance systems capable of detecting algorithm-generated abuse. MAR is directly applicable — meaning no member state can dilute its requirements.

4. Market Abuse Directive II — MAD II (Directive 2014/57/EU) Provides the criminal law sanctions framework complementing MAR, ensuring that serious market abuse including algorithmic manipulation is subject to criminal prosecution across member states.

5. Commission Delegated Regulation (EU) 2017/589 — Regulatory Technical Standard 6 (RTS 6) The most technically specific document in the EU framework. RTS 6 sets out the detailed requirements for algorithmic trading systems under MiFID II including governance arrangements, testing of algorithms, annual self-assessment, real-time monitoring, kill-switch functionality, and record-keeping obligations. This is essentially the operational rulebook for algo trading in the EU.

6. ESMA Guidelines on Systems and Controls in an Automated Trading Environment (2012 and 2014) Issued by the **European Securities and Markets Authority**, these guidelines provided pre-MiFID II guidance and continue to inform supervisory practice. They require firms to have robust risk controls, stress testing, and incident response plans.

7. General Data Protection Regulation — GDPR (Regulation EU 2016/679) Relevant to algorithmic trading in the context of data used for trading decisions, including personal and market data processing by automated systems.

8. EU Cybersecurity Act (Regulation EU 2019/881) Establishes cybersecurity certification frameworks that apply to the technological infrastructure supporting algorithmic trading platforms.

Key Characteristic of EU's Model: Codified, harmonized, transparency-driven, outcome-based, no algorithm-by-algorithm pre-approval, comprehensive documentation and governance obligations, ESMA-led uniform implementation across 27 member states.

UNITED STATES — Key Frameworks

1. Securities Exchange Act of 1934 The foundational federal securities legislation. Sections 9 and 10(b) and Rule 10b-5 provide the primary legal basis for prosecuting market manipulation and fraud including algorithmic manipulation. The Act gives the SEC broad authority to regulate broker-dealers, exchanges, and trading practices.

2. Commodity Exchange Act, 1936 (CEA) Governs the regulation of futures, options, and swaps markets under CFTC oversight. Section 4c(a) of the CEA as amended by Dodd-Frank explicitly bans spoofing in derivatives markets, making it the primary statutory basis for prosecuting HFT-related manipulation in futures markets.

3. Dodd-Frank Wall Street Reform and Consumer Protection Act, 2010 Passed in response to the 2008 financial crisis, Dodd-Frank significantly expanded the CFTC's jurisdiction over derivatives and gave it explicit anti-spoofing enforcement authority. Section 747 introduced the spoofing prohibition making it illegal to bid or offer with the intent to cancel before execution directly applicable to algorithmic traders.

4. Market Access Rule — Rule 15c3-5 under the Securities Exchange Act One of the most important direct regulations for algorithmic trading. Requires all **broker-dealers with market access** to establish pre-trade risk management controls and supervisory procedures to prevent erroneous orders, excessive exposure, and unauthorized trading. Introduced by the SEC in 2010 directly in response to the Flash Crash.

5. Regulation SCI — Regulation Systems Compliance and Integrity Adopted by the SEC in 2014, Regulation SCI applies to exchanges, clearing agencies, alternative trading systems, and plan processors. It requires covered entities to have **robust and resilient technological systems**, conduct annual reviews and stress testing, and immediately report system disruptions to the SEC. While it does not regulate algorithms directly, it governs the infrastructure on which algorithms operate.

6. CFTC Regulation Automated Trading — Reg AT (Proposed, not finalized) The CFTC proposed Reg AT in 2015 as a comprehensive framework for automated trading in derivatives markets, including requirements for pre-trade risk controls, algorithm testing, and regulatory access to source code. Due to strong industry

opposition — particularly regarding source code access Reg AT was never finalized. Its proposal nonetheless established the policy debate around comprehensive algo regulation in the US.

7. FINRA Rules on Supervision — Rule 3110 and Rule 3120 The **Financial Industry Regulatory Authority** requires broker-dealers including those using algorithmic strategies to establish and maintain supervisory systems and written supervisory procedures. These rules place compliance obligations on firms employing automated trading.

8. SEC Regulation ATS — Alternative Trading Systems Regulation Regulates electronic trading platforms including dark pools that execute algorithmic orders. Requires registration, transparency reporting, and fair access provisions.

9. U.S. Federal Information Security Management Act, 2002 (FISMA) Provides the cybersecurity framework applicable to financial market participants and regulators.

Key Characteristic of US's Model: Principles-based, enforcement-driven, decentralized, no pre-approval, firm-level internal governance responsibility, strong ex-post enforcement, self-regulatory organization reliance, innovation-friendly but reactive.

Chapter 3 — Technical and Conceptual Foundations of Algorithmic Trading

Chapter 3 establishes the technical and conceptual groundwork necessary to understand the legal discussions that follow. It begins by defining algorithmic trading as the use of computer programs and mathematical models to execute trading decisions based on pre-set parameters like price, timing, and volume removing human discretion from the process. The chapter traces its evolution from basic program trading in the 1980s to the sophisticated high-frequency trading systems of today, explaining how technological advancements like electronic exchanges, co-location services, and ultra-low latency networks transformed markets. It then classifies the major types of algorithmic strategies execution-based strategies like VWAP Volume Weighted Average Price and TWAP Time Weighted Average Price, arbitrage strategies, market-making strategies, momentum ignition, news-based strategies, and machine learning driven strategies each carrying different regulatory and ethical

implications. The chapter also examines the technological infrastructure matching engines, low-latency networks, clearing systems, and RegTech surveillance tools and concludes by assessing both the benefits of algorithmic trading such as improved liquidity, price discovery, and execution efficiency, and its risks including flash crashes, market manipulation, operational failures, and access inequality, thereby establishing why robust legal regulation is not optional but essential.

Chapter 4 — Comparative Analysis of Algorithmic Trading Regulation — India, EU, and US

Chapter 4 is the analytical heart of the dissertation and directly addresses the comparative dimension of the research. It examines India's regulatory framework under SEBI which has evolved through a series of circulars from 2012 to 2025 establishing exchange-level pre-approval of algorithms, mandatory risk controls like kill switches and order-to-trade ratio thresholds, audit trail obligations, and most recently the retail algorithmic trading framework all without a single comprehensive statute, making it prescriptive but legally fragmented. It then analyses the EU's framework anchored in MiFID II Markets in Financial Instruments Directive II, MiFIR — Markets in Financial Instruments Regulation, and MAR Market Abuse Regulation, which together create a codified, harmonized, and transparency-driven regime with formal definitions, governance obligations, senior management accountability, and ESMA-led uniform implementation through binding RTS 6 without requiring algorithm-by-algorithm pre-approval. The chapter then examines the US framework built on the Securities Exchange Act 1934, the Commodity Exchange Act 1936, the Dodd-Frank Act 2010, the Market Access Rule Rule 15c3-5, and Regulation SCI, which represents a principles-based, enforcement-driven model that relies on internal firm governance, self-regulatory bodies like FINRA, and post-trade enforcement rather than pre-approval. The comparative chart at the end of the chapter synthesizes these differences across parameters including regulatory philosophy, pre-approval requirements, HFT regulation, market abuse frameworks, surveillance infrastructure, and AI governance concluding that India over-regulates process and under-regulates outcomes compared to its international counterparts.

Chapter 5 — Regulatory Complexities, Systemic Risks, and Jurisprudential Challenges

Chapter 5 moves beyond the structural comparison to examine the deeper legal and systemic challenges that algorithmic trading frameworks across all three jurisdictions struggle to adequately address. It first tackles the problem of algorithmic opacity where the black-box nature of automated systems makes it extremely difficult to attribute liability when an algorithm causes market harm, since traditional legal frameworks are built around identifiable human intent and decision-making. It then examines how conventional market abuse doctrine designed for human traders is being stretched to cover algorithm-driven manipulation techniques like spoofing, layering, quote stuffing, and momentum ignition, noting that while the EU's MAR and the US Dodd-Frank Act explicitly cover these practices, India's PFUTP Regulations remain intent-based and therefore inadequate for fully automated misconduct. The chapter analyses systemic risk and the limits of event-driven regulation, using the 2010 US Flash Crash as the central example of how interconnected algorithms can trigger cascading market failures faster than any regulatory mechanism can respond. It further examines the problem of supervisory capacity where SEBI and even more resourced regulators like the SEC lack the real-time technological capability to monitor the speed and volume of algorithmic activity effectively. The chapter concludes by discussing the future of regulatory design in the context of AI and machine learning, arguing that all three jurisdictions need to shift toward adaptive, technology-neutral governance frameworks that focus on accountability and explainability rather than rigid pre-approval processes.

Chapter 6 — Judicial Verdicts Related to Algorithmic Trading

Chapter 6 examines how courts and tribunals across India, the EU, and the US have shaped the regulatory and legal landscape of algorithmic trading through their judgments and enforcement decisions. In the Indian context, it analyses the role of the Securities Appellate Tribunal — SAT — and the Supreme Court in adjudicating disputes involving SEBI's regulatory actions, highlighting landmark cases such as *SEBI v. Rakhi Trading Pvt. Ltd. (2018) 13 SCC 753* which established that automated order placement can attract liability under the PFUTP Regulations, *National Stock Exchange of India Ltd. v. SEBI (2019) SAT Appeal No. 68 of 2016* which addressed the NSE co-location controversy and reinforced fair access obligations, and *Ketan Parekh v. SEBI (2006) 68 SCL 121 (SAT)* which remains a foundational precedent on market manipulation. In the international context, the chapter examines *United States*

v. Coscia (2017) 866 F.3d 782 the first criminal conviction for algorithmic spoofing in the US under Dodd-Frank and *CFTC v. Navinder Singh Sarao (2015)* the case against the trader whose spoofing algorithm contributed to the 2010 Flash Crash both of which established that algorithmic intent can be inferred from trading patterns and strategy design. The chapter concludes that judicial intervention has been critical in filling gaps left by regulatory frameworks, particularly in clarifying liability standards and extending existing market abuse doctrines to algorithmic conduct, but also highlights that the pace of litigation is far too slow relative to the speed of technological change in financial markets.